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Correlation and path analysis in garden pea (*Pisum sativum* L.)

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Abstract
The experiment was conducted in order to estimate the character association for eleven traits in thirty diverse garden pea genotypes during *Rabi* season of 2018-19 at the Research Farm, Department of Vegetable Science, College of Horticulture, Mudigere. Quantitative analysis were carried out for all the characters which are directly or indirectly associated with the yield and yield contributing traits. The correlation studies revealed that pod yield per plant exhibited highly positive and significant character association with number of pods per plant and weight of ten pods. Therefore, these traits may be considered as the most reliable selection indices for effective improvement in yield.

Keywords: Garden pea, character association, path analysis

Introduction

Pea (*Pisum sativum* L.) commonly called as matar, garden pea, sugar pea and snap pea. It belongs to the family Fabaceae (Leguminosae) with the chromosome number 2n=14. It is native of Central Asia, the Near East, Abyssinia, and the Mediterranean is considered as center of origin based on genetic diversity. According to Blixt (1970) [2], the Mediterranean is the primary centre of diversity with secondary centre in Ethiopia and the Near East. In Karnataka, it is grown in an area of 1,760 ha with the production of 23,192 metric tonnes and the productivity is 13.17 metric tonnes per hectare (Anon., 2017). Bengaluru urban, Bengaluru rural and Chikkaballapura are the leading producers of garden pea. It is a cool season crop and it is mainly grown as winter crop in plains and summer crop in hills of India. For effective breeding programme one must know the character association between yield and its component traits. Yield is a quantitative character and is associated with component characters. Therefore present investigation was carried out to get knowledge about mutual relationship between various characters and to determine the direct and indirect effects of each component towards yield.

Materials and Methods

This study was designed to work out the association of different yield traits, direct & indirect effects of these traits on pod yield among thirty garden pea genotypes during Rabi season of 2018-19 at Research Farm of College of Horticulture, Mudigere, (Karnataka). The seeds of different genotypes were collected from IIHR, Bengaluru and other various seed companies. The experiment was laid out in Randomized Block Design which was replicated twice.

The observations were recorded on randomly selected five plants from each genotype for eleven characters *viz*. Plant height @ 60 DAS(cm), number of branches per plant @ 60DAS, days taken for first flowering, days taken for first picking, number of pods per plant, pod length (cm), pod width (mm),thickness of pod (mm), weight of ten pods(g), shelling per cent, number of seeds per pod and pod yield per plot (g). Correlation and path analysis were estimated according to the method advocated by to Wright (1921) [20] and Dewey and Lu (1959) [4].

Results and Discussion

The data pertaining to the phenotypic correlation coefficients and genotypic correlation coefficients for different characters of garden pea genotypes are presented in Table 1 and table 2.

The present investigation exhibited that the genotypic correlation coefficients showed higher values for most of the independent traits than the phenotypic correlation coefficients, depicting that there is a strong inherent association between the various characters studied. Further, the narrow difference between phenotypic and genotypic correlation coefficients indicates that there is no much influence of environment in determining the association of attributing characters with pod yield per plant and due to strong genetic makeup of the evaluated material. Strong positive association of characters with yield may be attributed to linkage and pleiotropy.

Positive and significant association of pod yield per plant with number of branches at 60 DAS, number of pods per plant and shelling per cent was observed. These finding are in agreement with the observations of Yadav *et al.* (2010) [21], Pal and Singh (2012) [16], Lal *et al.* (2018) [14]. The results indicate the possibility of simultaneous selection for improvement of these traits.

Positive and significant correlations were observed in respect of number of branches at 60 DAS showed positive association with number of pods per plant and shelling per cent whereas negative significant association with weight of ten pods and number of seeds per pod. These finding are in confirmation with the observations of Pal and Singh (2012) [16], Khan *et al.* (2017) [8], Lal *et al.* (2018) [14]. These traits can be used as a criterion during selection.

Days to first flowering exhibited significant positive correlation with days to first picking, length, width and thickness of pod whereas negative significant correlation with average weight of ten pods. These results are corroborated with the findings of Yadav *et al.* (2010) [21], Pal and Singh (2012) [16], Kumar *et al.* (2010) [10], and Kumar *et al.* (2015) [11, 12]

Days to first harvest with number of pods per plant showed negative association, while it exhibited positive and non-significant correlation with number of pods per plant, shelling per cent and number of seeds per pod. Length, width, and thickness of pod recorded positive and significant association with pod yield per plant. Similar results were in accordance with Yadav *et al.* (2010) [21], Pal and Singh (2012) [16] and Kumar and Singh (2012) [16].

Number of pods per plant showed positive significant association with width thickness and shelling per cent. These results are in line with those of Yadav *et al.* (2010) [21],

Table 1: Phenotypic correlation coefficient among growth and yield parameters in garden pea genotypes

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12 (r_p)**
1	1.0000	0.7484**	0.0663	-0.1326	0.6785**	-0.2148	0.2323	0.1790	-0.4471**	0.4638**	-0.3435*	0.0892
2		1.0000	-0.0029	-0.0919	0.5773**	-0.2260	0.1322	-0.0395	-0.2714*	0.3944*	-0.3435*	0.0780
3			1.0000	0.8208**	0.0493	0.3214*	0.5682**	0.4556**	-0.5360**	0.0087	0.0876	-0.1302
4				1.0000	0.0555	0.3619**	0.5242**	0.4424**	-0.4287**	0.1399	0.0931	-0.1696
5					1.0000	-0.1491	0.4119*	0.3243*	-0.2772*	0.3090*	-0.2476	0.3279*
6						1.0000	0.2221	0.2305	-0.0111	0.1516	0.5055**	0.2170
7							1.0000	0.8485**	-0.3973*	0.2520	-0.0748	0.0655
8								1.0000	-0.4846**	0.2460	-0.0120	-0.0605
9									1.0000	-0.1983	0.3467*	0.3166*
10										1.0000	0.0039	-0.1265
11											1.0000	-0.0684

Critical r_g value 5%- 0.254 significant at p= 0.05 Critical r_g value 1%- 0.330 significant at p= 0.01

1. Plant height (cm) 60 DAS
2. No. of branches/plant 60 DAS
3. Days taken for first flowering
4. Days taken for picking
5. Number of pods/plant
6. Length of pod (cm)
7. Width of pod (mm)
8. Thickness of pod (mm)
9. Weight of ten pods (g)
10. Shelling per cent
11. No. of seeds/pod
12. Pod yield/plant (g)

Table 2: Genotypic correlation coefficient among growth and yield parameters in garden pea genotypes

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	1.0000	0.7646	0.0645	-0.1333	0.6857	-0.2366	0.2405	0.1842	-0.4803	0.4796	-0.3862	0.0885
2		1.0000	0.0043	-0.1018	0.5995	-0.2673	0.1367	-0.0444	-0.3128	0.4198	-0.4109	0.0751
3			1.0000	0.8378	0.0462	0.3575	0.5942	0.4673	-0.5848	0.0115	0.1008	-0.1293
4				1.0000	0.0581	0.3755	0.5535	0.4568	-0.4741	0.1396	0.0896	-0.1701
5					1.0000	-0.1450	0.4200	0.3297	-0.2960	0.3278	-0.2750	0.3338**
6						1.0000	0.2397	0.2495	-0.0509	0.1461	0.6050	0.2391
7							1.0000	0.8736	-0.4300	0.2822	-0.0707	0.0734
8								1.0000	-0.5272	0.2511	-0.0059	-0.0564
9									1.0000	-0.2013	0.3570	0.3451**
10										1.0000	0.0019	-0.1283
11											1.0000	-0.00871

Critical r_g value 5%- 0.254 significant at p= 0.05 Critical r_g value 1%- 0.330 significant at p= 0.01

1. Plant height (cm) 60 DAS
2. No. of branches/plant 60 DAS
3. Days taken for first flowering
4. Days taken for picking
5. Number of pods/plant
6. Length of pod (cm)
7. Width of pod (mm)
8. Thickness of pod (mm)
9. Weight of 10 pods (g)
10. Shelling per cent
11. No. of seeds/pod
12. Pod yield/plant (g)

Table 3: Phenotypic path coefficient among growth and yield parameters in garden pea genotypes

	1	2	3	4	5	6	7	8	9	10	11	r_p (12)
1	0.0952	0.0713	0.0063	-0.0126	0.0646	-0.0205	0.0221	0.0170	-0.0426	0.0442	-0.0327	0.0892
2	-0.0872	-0.1165	0.0003	0.0107	-0.0672	0.0263	-0.0154	0.0046	0.0316	-0.0459	0.0400	0.0780
3	0.0154	-0.0007	0.2328	0.1910	0.0115	0.0748	0.1322	0.1060	-0.128	0.0020	0.0204	-0.1302
4	0.0345	0.0239	-0.2133	-0.2599	-0.0144	-0.0941	-0.1362	-0.1150	0.1114	-0.0364	-0.0242	-0.1696
5	0.3793	0.3227	0.276	0.0310	0.5591	-0.0833	0.2303	0.1813	-0.1550	0.1727	-0.1384	0.3279
6	-0.1250	-0.1316	0.1871	0.2107	-0.0868	0.5822	0.1293	0.1342	-0.0065	0.0882	0.2943	0.2170
7	0.0058	0.0033	0.0143	0.0132	0.0104	0.0056	0.0252	0.0213	-0.0100	0.0063	-0.0019	0.0655
8	-0.0145	0.0032	-0.0370	-0.0359	-0.0263	-0.0187	-0.0689	-0.0812	0.0393	-0.0200	0.0010	-0.0605
9	-0.2578	-0.1565	-0.3091	-0.2472	-0.1598	-0.0064	-0.2291	-0.2794	0.5767	-0.1144	0.1999	0.3166
10	-0.1028	-0.0874	-0.0019	-0.0310	-0.0685	-0.0336	-0.0559	-0.0545	0.0440	-0.2217	-0.0009	-0.1265
11	0.1463	0.1463	-0.0373	-0.0396	0.1055	-0.2153	0.0319	0.0051	-0.1477	-0.0017	-0.4260	-0.0684

R SQUARE = 0.5692 RESIDUAL EFFECT = 0.6564 r_p- Phenotypic correlation coefficients with pod yield per plant

Diagonal values indicates direct effect

1. Plant height (cm) 60 DAS
2. No. of branches/plant 60 DAS
3. Days taken for first flowering
4. Days taken for picking
5. Number of pods/plant
6. Length of pod (cm)
7. Width of pod (mm)
8. Thickness of pod (mm)
9. Weight of ten pods (g)
10. Shelling per cent
11. No. of seeds/pod
12. Pod yield/plant (g)

Katiyar *et al*. (2014) [6], Kumar *et al*. (2015) [11, 12], Katoch *et al*. (2016) [7], Thakur *et al*. (2016) [19] and Devi *et al*. (2017) [3]. Length of pod and average weight of ten pods showed positive and significant correlation with number of seeds per pod. Results are in agreement with the findings of Nawab *et al*. (2008) [15], Yadav *et al*. (2010) [21], Pal and Singh (2012) [16], Kumar *et al*. (2015) [11, 12], Katoch *et al.* (2016) [7] and Devi *et al*. (2017) [3].

Pod yield per plant showed highly significant positive correlation with number of pods per plant and weight of ten pods both at genotypic and phenotypic level. Suggesting that these characters could be considered as major green pod yield contributing characters in pea. These findings are in line with the reports of earlier researchers Kumar *et al.* (2010) [10], Ram *et al*. (2010) [10], Pal and Singh (2012) [16], Kumar *et al.* (2014), Heena *et al.* (2016) and Devi *et al.* (2017) [3]. These correlations suggest that selection of these component traits will be effective in improving yield of pea.

The direct and indirect effects of different characters on pod yield per plant are presented in Table 3. Both at genotypic and phenotypic level, path coefficient analysis of the different characters revealed that number of pods per plant had highest positive direct effect on pod yield per plant followed by weight of ten pods, length of pod, plant height at 60 DAS, number of branches per plant at 60 DAS and width of pod. This indicates true relationships with pod yield per plant and direct selection for this trait would result in higher breeding efficiency for improving yield. Thus, this trait might be reckoned as the most important component trait for pod yield per plant. The results are in propinquity with Sharma *et al.* (2007) [18], Kumar *et al*. (2010) [10], Ram *et al.* (2010) [10], Heena *et al.* (2016) [5], Devi *et al.* (2017) [3], Kumawat *et al.* (2018) [13] and Lal *et al*. (2018) [14] whereas days to first picking had the highest negative direct effect on pod yield per plant followed by days to first flowering, number of seeds per pod, thickness of pod and shelling per cent. Hence simultaneous selection for these characters can be made for the improvement of yield. The results corroborated the findings of Pal and Singh (2010) [10], Kumar *et al.* (2010) [10], Kumar *et al*. (2015) [11, 12] and Lal *et al.* (2018) [14].

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